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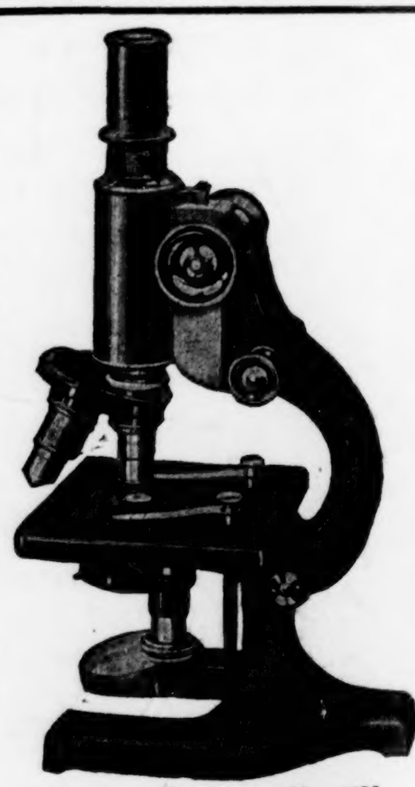

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PROBLEMS OF POPULATION OF THE NORTH PACIFIC AREA AS DEPENDENT UPON THE BIOLOGY, THE OCEANOGRAPHY, AND THE METEOROLOGY OF THE AREA[1]

FOR long ages before written records began, human migrations seem to have taken place over the vast Pacific region. These apparently affected the islands of the south, those of the north, and those of the the middle portions, as likewise the continental littorals of Asia and North America. Later came the era, very recent as all human history goes, of the drifting of Chinese and Japanese fishing junks upon the northern American coast, and of castaway Japanese traders upon the Mexican coast. Following this came the truly modern era, ushered in, one may fairly say, by President Fillmore's appeal to the Emperor of Japan, through the Perry embassy, for the opening up of the Hermit Kingdom in the interest of American industrial and commercial development as represented by the whale fishery, and closely identified with gold mining in California. Shortly thereafter, followed the bringing of Chinese coolies for labor in building the Pacific end of the first transcontinental railroad.

Through all these, and many other events of similar import, on down to this very summer of 1919, when hardly a day passes in which the newspapers do not contain items of some sort involving the activities of Japanese or Chinese in the industrial and commercial life of Pacific North America, can be seen a contact of Asiatics and Americans—a kind of community of interests—made not only pos-

[1] The opening paper of a symposium on "The exploration of the North Pacific Ocean," held at the Pasadena meeting, Pacific Division, American Association for the Advancement of Science, June 19, 1919.

sible, but seemingly inevitable, by their common possession of the great ocean, and of the human propensities for adventure, travel and gain.

In another connection I have called attention to the variety of meanings which naturally attach to such phrases as "The Problem of the Pacific," "The New Pacific," etc.[2]

The wording of the topic, assigned to me in this symposium, when read in the light of the above reflections and along with the other topics of the program, suggests the direction my remarks should take. To the eyes of science, the situation as touching the peoples of the north Pacific area is this: Some 500,000,000 Asiatics are being brought into ever closer contact with some 6,000,000 Americans, the Asiatics being so placed geographically that scores of millions of them have about the lowest per capita allotment of any peoples on the earth of some of the primary material necessities of human life, while the Americans are so placed as to give them about the highest of such allotment.

That economic equilibrium will tend to establish itself between these two peoples is as certain as that two bodies of salt water of different density will tend to come to an equilibrium if in contact with each other.

There are two ways in which this equilibrating tendency may work itself out. (1) It may proceed in accordance with the brute instincts of self-preservation and self-realization. This is the way of material force working as modern commercialism and modern militarism. Frequently as the resemblance between these two gigantic forces has been noticed, it yet seems not to have been sufficiently brought home to many of us. (2) The other way in which the equilibrating tendency may realize itself is in accordance with the human reason for self-preservation and self-realization. This is the way of modern intelligence and rationality; in other words, of modern science.

Perhaps some one will question the warrantableness of including all the Chinese, Japanese and Koreans, as I did a moment ago, when speaking of Asiatic populations, while only the small portion of all North Americans are included which live on the Pacific slope. If question of this sort be raised, my reply is that being naturalists, we are bound to think in terms of nature—especially of geography—whenever we speak comprehensively of people; and hence must look at population in relation to the continental slopes, drainage areas, oceanic and fluviatile waterways, etc., which constitute their major physical environments. The "North Pacific area" is clear enough of definition geographically viewed: It includes not merely the great north ocean itself, with its islands, but also those parts of the adjacent continents, Asia and North America, whose rivers flow into the ocean. In an important sense this is a unit area of populational distribution as it is of physical geography.[3]

Pacific North America, as thus defined, seems to be as natural a depositing ground for immigrants from eastern Asia as Atlantic North America is for immigrants from Europe. While manifestly it would be easy to push such a criterion of unit area of peoples too far, yet recognition of it to the extent of its validity is of great practical importance.

The fundamental nature of the issue between Asiatics and Americans is clearly reflected in the character of the American legislative measures which have been proposed, and in some instances made into law, against the immigration of Asiatics.

That the issue is not primarily one of race

[2] "The Problem of the Pacific," Bull. No. 8, Scripps Institution for Biological Research, University of California, June 14, 1919.

[3] In *Fundamental Geological Problems of the North Pacific Ocean Region*, contributed to the symposium by George D. Louderback, occurs this: "The contrast between the geologic and geographic conditions of the eastern states and of the Pacific states of the United States is marked, and their geologic history is to a considerable extent unrelated, while there are striking similarities between the conditions obtaining along the eastern and western coasts of the North Pacific Ocean." This is interesting and may be significant taken in connection with my suggestion of a "unit area of populational distribution."

is shown by the fact that the exclusion proposals are never aimed at Asiatics indiscriminately. Without exception, I think, the measures apply only to Asiatics upon whom the economic conditions of their native lands rest most heavily; those, namely, who live by the toil of their hands. The classes—public officials, persons of large affairs, professional men, and students—who enjoy considerable economic independence, are welcome in America, travel widely over the continent, and mingle freely and pleasantly with the citizens everywhere. Because of their approximate economic and cultural equality with those among whom they are, and because of the smallness of their number, these classes of Asiatics give rise to no perplexities, economic, racial or of any other kind.

The race element undoubtedly comes into the labor immigration problem with great force finally, but only as a consequence of economic conditions, and at the locus of greatest pressure of these conditions. Except for the economic element almost certainly there would be no problem of Asiatic immigration for the simple reason that there would be no such immigration.

The sole, or at least the chief motive of Asiatic laborers in coming to America is to improve their hard economic lot. And because of the restraint upon their travel which this hard lot imposes, they are bound to take advantage of the first chance which presents itself for accomplishing their aim.

No Chinaman who has barely money enough to pay the cheapest steamer passage across the Pacific, is going to the additional expense of a railroad journey to Kansas City or St. Louis for work if he can get as good wages in Seattle or San Francisco. And no Japanese farmer who crosses the Pacific under like conditions is going to the Mississippi valley to raise corn and wheat, if he can do better raising potatoes or berries or celery on the bottom lands of the Sacramento and Colorado rivers. Nor is any Chinaman or Japanese going to Lake Michigan or Cape Cod to fish if he can do as well fishing at Monterey or San Pedro. But these basal considerations are not the sole, nor even the most important ones bearing on the case.

Not only is Pacific North America the natural depository for the semi-destitute peoples of eastern Asia who migrate to America, but as long as there exists an immense Asiatic population in such economic condition, and as long as there exist such alluring chances in Pacific America for relieving that condition, it is hardly possible that any device of politics or law or any gentlemanly arrangements will be able to permanently stay the movement for such betterment. The problems concern some of the most elemental and mighty forces of human nature—the forces which antedate and condition politics and law and gentlemanly conduct, as the tree with its roots antedates and conditions the tree with its blossoms and fruit.

During these very last weeks comes the report that 5,000 Asiatics came into the Pacific States of Mexico during March, 1919, and that the total immigration to that country last year was 100,000. And entrance into Pacific Mexico means an entrance into Pacific United States sooner or later. So subtle and pervasive and powerful are the forces which are impelling Asiatic immigration into America that exclusion treaties and laws and other mere contractual arrangements will be incapable of controlling them.

Am I not right in supposing it is the complexity and subtlety of these forces—economic in the sense of physical poverty affecting the great masses of Asiatics; racial as affecting these same portions of both Asiatics and Americans; and instinctive of self-preservation and self-realization of all the people of both continents—that makes the growing breach in the traditional friendships between the United States and Japan incomprehensible to the acutest observers of both countries? "I do not know how to account for it," frankly and almost despairingly declares Baron Shibusawa, one of the oldest and most intelligent of Japan's business students of America. And the replies which he records having received from distinguished Americans to whom he appealed for light, shows that

they are really as much in the dark as he is. One of these Americans, he tells us, assured him, that "the little cloud overhanging the sky will soon pass away."

Terrible, I warn both America and Asia, will prove the illusion if it goes uncorrected, that the ill-will growing between these two old-time friends is only a little cloud that will soon pass away!

But is the gigantic tornado which impends, to be regarded as a fate—as a thing in the hands of a purpose and a power wholly unapproachable, unmodifiable by man? No and ten times no; is my answer. We can convert the devastating tornado into a benign and fructifying wind-and-rain if we so resolve and act according to our resolution.

To point a way, and I am quite sure the only way, toward such resolution and such action is the central aim of my part in this symposium.

My first move in this shall be to remind ourselves that, as a few observers of anti-Asiatic "agitation," often so-called, of the Pacific states have remarked, this agitation is at bottom an expression of the instinct of self-preservation. This remark I wish to supplement by affirming that not only is the instinct of self-preservation on the part of the American agitators involved, but likewise there is involved not merely the same instinct of the Asiatics, but also the instinct of self-realization of both Asiatics and Americans. And I remark that he errs grievously whose observation on instincts has not recognized the difference between the instinct of self-preservation and that of self-realization.

But the point which I wish particularly to fix attention upon in the remarks just made is that the problem as it is actually presenting itself to us, lies chiefly in the domain of human instinct and passion; and that this is only another way of saying that it does not lie chiefly in the domain of human reason.

The quintessence of the proposal I am going to make is that the problem shall be so shifted in its locus that instead of lying primarily in the domain of instinct and only secondarily in that of reason, it shall lie primarily in the domain of reason, of intelligent life and action, and only secondarily in the domain of instinct, of instinctive life and action. And may I not believe that at least in the group of men and women here assembled, scientific as we all are, this proposal shall not be received with listless toleration, as a mere academic pronouncement?

In the interest of grounding my proposal a little more securely on fundamental principle, I remind you of the familiar characterization of all instincts as "blind." And note the unerring truthfulness of our common modes of expression: The "instinct *of*" self-preservation and of self-realization, we say: The instinct of existence is in the very essence of existence itself. Not so with reason. The "reason *for*" we automatically say, self-preservation and self-realization. Existence must justify itself, according to reason. Furthermore, reason must concern itself with the modes and means of existence.

My proposal that the problem of the peoples of the Pacific area shall be carried up so that its larger moiety may lie in the domain of reason instead of in the domain of instinct, means that the Chinese and Japanese and Koreans and Siberians and British Columbians and United Statesans and Mexicans shall take much thought about their self-preservation and self-realization—about why they should be preserved and why they should realize their desires and ambitions; and about the manner in which they should exist and the means by which this may be and ought to be accomplished.

It means, in other words, that the problem should be one of science at its fullest and best; science as the great body of observational and reflective truth concerning external, or material nature, and science as the great body of observational and reflective truth concerning the internal, or spiritual nature of man. And this means economic and cultural justice and morality, international as well as national.

A cardinal aim of all effort in accordance with the principles here indicated, would be to remove the one great inducement to Asiatic

migration to America, namely, the grinding poverty under which the great masses of hand laborers of Asia live at home. Surely it would be disastrous to both western America and eastern Asia as wholes, for the former to become Asiaticized to the extent that the Hawaiian Islands have become so. But the only rational way and, as I believe, the most effective and practical way to prevent this is to make the economic conditions of Asiatic laborers in Asia at least approximately as favorable to them as are the conditions which they find in America.

If statesmanship pronounces this an utterly unrealizable ideal, it thereby merely declares its own incompetency to bring it about, this incompetency being due to the fact that statesmanship of the traditional sort is not primarily a thing of comprehensive, accurate knowledge and reason, but rather only of partial knowledge and of instinct and impulse. And this raises the question, very pertinent at this time: What has been in general the fundamental nature of political motive and action, especially as between nations, down to this time? Has it been mainly rational and intelligent, or has it been mainly instinctive and passionate? Let history answer.

In the cataclysmic condition of the world to-day, three occurrences in particular are recognizable which should encourage the attempt to deal with the Asiatic-American problem on the principles I am setting forth. (1) The revised covenant for the League of Nations (which will surely soon be adopted if reason is indeed now to be enthroned in the government of the world), making the League the central body for coordinating and promoting international activities generally; (2) the provisions of the covenant relating to labor problems which are international in scope; (3) the determination by the American Federation of Labor at the Atlantic City convention (according to press dispatches) to cooperate with Japanese workers for bringing about a better understanding between working men of Japan and the United States.

I venture to predict that were the agencies and movements here indicated to become really active in behalf of the Asiatic-American problem, they would inevitably move in the direction of some such solution of it as I am indicating.

A thing that science can say which ought to contribute much as an initial step in this direction is that the civilized world may assure itself that given adequate scientific investigation and utilization of the resources of nature; and given a due measure of scientific knowledge and of the spirit of justice and morality in politics and law in national and international affairs; and given, further, a due sway of reason in the growth of population, and no people of the world need live in danger of starvation or even of serious want. The proposition is surely susceptible of something approaching demonstration that the dogma of the inevitability of material poverty for great sections of the world's population is a mark of primitiveness, of immaturity of human societies.

And I wish here to affirm the unhumanness of national policies which encourage large families in the interest of large armies and cheap labor.

Probably the foremost significance of reason in the human animal is that it is the device or agency developed by nature to relieve the species from the uncertainty and precariousness of material sustenance as instinct alone is able to secure it.

To develop the latent natural resources of the whole Pacific area, of land and water alike, and then to distribute and use the fruits obtained in such fashion that all portions of all the populations shall be beneficiaries in just ratio, would be exactly one of the most characteristic things which these peoples could do as rational, *i. e.,* as truly human animals.

This paper and those to follow in this symposium are so many indices of what would be involved in carrying out such a proposal so far as the great ocean itself is concerned.

Many decades of common experience with, and scientific research upon the oceans of the earth, the atmosphere which overspreads them,

and the life which teems in their waters, have yielded large knowledge. Much of this knowledge is revelatory of great riches in living beings useful to man. And revelatory, too, is the knowledge of how intimately the life and health and happiness of men are dependent upon the oceans themselves because of certain of their physical and chemical attributes; and upon the atmosphere which is a sort of vital nexus between sea and land.

But the knowledge thus far obtained as to these beneficences is hardly more than an outline the details of which are yet to be filled in.

The papers which are to follow will present portions of the sketch more clearly, and will indicate in some particularity what filling in of details would probably show, and the means by which the task would have to be done.

Far more knowledge is essential as to what useful organic resources the waters contain; as to how these may be utilized; and as to how they may be made permanent as well as useful.

Greater knowledge of the ocean itself and the atmosphere must be had in order that the harvesting and the conserving of its resources may be more certain and safer; in order that all travel upon the sea may be facilitated; and in order that those aspects of the land's productiveness which are largely influenced by the conditions of the sea may be brought more under the control of man.

Knowledge, and ever more knowledge, is the watchword in this aspect of the great problem: and of such nature and so broad is the requirement that it is well nigh indispensable that all the peoples whose interests are involved should participate in securing it. Common needs of world-population demand common world scientific research and world effort in affairs.

And now, taking this very meager statement as a foundation to go on, I venture to summarize, in the name of world science and the spirit of it, what the problem of peoples of the Pacific area is, and by what methods it could be resolved. It is a problem in which the two elements of economics and race are so enormously potent that little wonder need attach to the fact that many students anxiously observing the animosity growing up between Japan and the United States particularly, conceive that the problem is wholly either the one or the other, or at most both of these elements. But not so. It is a problem of the whole gamut of human nature as this manifests itself in two great groups of highly and equally, though diversely civilized peoples of different though equal races, coming into economic conflict with each other.

And just because the two groups stand high and essentially equal in civilization; and just because each is within itself, predominantly guided by rational knowledge and conduct, the only possible real solution of the conflict between them must be likewise through rational knowledge and conduct. It is then heavily incumbent upon those men and women in both groups who are professed and acknowledged leaders in the life of the intellect, not only to bring home to our fellows what is involved in this way of solving the problem, but also to bring home to them what would almost certainly result from leaving the problem where it now is, namely predominantly in the realm of instinct and passion. This last means that our duty is to proclaim the indubitable fact that the counterpart of the instinct of self-preservation throughout the whole animal creation is the fighting instinct; and that consequently fighting—war—will be an almost certain consequence of leaving the problem where it is, this implying an almost certain irrational, unjust, and destructive treatment of the problem.

And upon those of our fellows, the numbers of whom are, unfortunately, neither few nor powerless, who oppose the rule of reason in such matters, and favor the rule of instinct, let us not fail to impress the lesson of Germany at this hour, as an example of the doom that awaits any modern nation whose international conduct is based more on instinct and brute force than on reason and moral force.

"All that take the sword shall perish with the sword." The profound natural truth which comes to expression in this familiar

phrase, has never been more terrible exemplified than by Germany, yesterday wielding her vast might of intellect and muscle to dominate the world; to-day cast down to the very dust and utterly impotent.

Nature herself, working through the process we have named evolution, has produced an agency, the human reason and intelligence, one of the main purposes of which is to find a better way, *i. e.*, a more efficacious, more certain, and less destructive way than war for solving problems of human preservation and realization.

Wm. E. Ritter

La Jolla, Calif.,

SOME NECESSARY STEPS IN ANY ATTEMPT TO PROVE INSECT TRANSMISSION OR CAUSATION OF DISEASE

The study of the causation of disease is attracting far more attention to-day than it ever has in the past, but it is to be regretted that there is not a larger proportion of this effort being directed toward locating the possible intermediate hosts and invertebrate carriers.

Many excellent investigations have been carried out with all other phases complete, but the question of invertebrate carriers is often left in a very indeterminate stage. The majority of the investigations which have been seriously undertaken to determine invertebrate carriers have been conducted on other continents than ours. There is a great field for investigation along these lines open to investigators in America. In order to stimulate such research, I have attempted in this paper to set down some of the necessary steps for successful investigation.

I. COOPERATION

I consider essential to a thorough investigation of disease transmission, the establishment of a perfect working agreement and hearty cooperation between one or more physicians and diagnosticians, one or more parasitologists, and one or more entomologists. It is not safe nor does the effort bring the proper amount of credence, when one man attempts to do the whole work. Each phase of such an investigation should be handled by an expert on that phase. The day of the solitary investigator is past and we are now in an era of group-investigations which carry with them weight and conviction. Of course certain preliminary steps may easily be taken by any one member of a proposed group or it may be possible that they may arrive at an advanced stage by independent work, but the time will come in each investigation when a cooperation of investigators will attain the most satisfactory results.

II. WHERE SHOULD THE INVESTIGATIONS OF INSECT TRANSMISSION BEGIN?

There are two distinct lines of approach to this problem of insect transmission. The first is to work from the known disease and to ascertain by experimentation what species of insects might be concerned in its transmission. The other line of approach is to make a study of all the insects whch might be involved in disease transmission and to obtain, by cultures and microscopic studies, a knowledge of the parasitic organisms normally and occasionally found in these insects. Working on this line of investigation, one might in time of an epidemic start with insects visiting excreta and attempt to ascertain whether the organism of the disease at that time epidemic occurs in any of these insects.

The first line of investigations would rise from public necessity and probably be initiated by physicans and parasitologists, or by the suggestion of entomologists.

The second line of investigations would probably originate as problems assigned by a professor or head of a laboratory to students or investigators under his direction. It is highly desirable that such studies be commenced in as many institutions as practicable in the near future. Such investigations will include bacteriological studies, protozoological studies and helminthological studies, as well as investigations of the life histories of the insects, and the possible connection between them and disease transmission.

III. PLAN OF OPERATION

Before starting out on any lines of experiment in this subject, there should be written down in concise form the facts already gleaned on the practical problems of the theories which have occurred to the various members of the group. A clearly outlined course of action should be made and be carefully discussed and then the various steps in the investigations thus outlined should be read and modified to meet the changing views resulting from the experiments. The course of the work should always be kept plainly in view. Each step should be rigorously and skeptically scrutinized for defects.

In as much as the investigation from this point will consist of the answering by observation and experiment of a series of pointed questions, I shall proceed with my discussion in the form of queries. Probably many other vital queries will occur to the reader, but it is more than possible that he may overlook some of these if not set forth here. When each query is satisfactorily answered the problem is practically solved.

IV. HOW CAN AN INSECT BE INVOLVED IN DISEASE TRANSMISSION

Insects[1] may be involved in disease transmission either by the transmission of an organism or the inoculation of a toxin or they may be an intermediate phase in the life cycle of an organism, but not come directly in contact with the final host.

1. *What kind of organisms can insects carry?*—It has been demonstrated that insects can carry bacteria, many types of protozoa and many species of parasitic worms, and also that certain species of insects may be instrumental in carrying eggs of other species of insects which cause disease.

2. *In what manner may insect toxins bring about disease?*—Many species of insects bite, and inoculate, at the time of the bite, a toxin which may at times cause serious trouble.

Some invertebrates inoculate the toxin by means of the mouth, some by means of a claw, some by means of a caudal appendage, others by means of the ovipositor. In some cases the invertebrate penetrates the skin with its mouth parts and as long as it is adhering, toxins are created which may in certain cases cause severe paralysis or death. The accidental eating of certain insects in food will cause poisoning because of the toxins contained in the bodies of these insects. It is believed, but not yet satisfactorily demonstrated that the pollution of food by the excreta of certain insects may cause certain nutritional diseases.

The presence of certain insects in the tissues causes severe irritations and often the formation of toxins.

3. *Can insects themselves cause disease?*—Many species of insects are known to live parasitically upon the bodies of man and animals and by their constant sucking of blood or gnawing, cause skin diseases. Other species of insects habitually lay their eggs on or in the flesh and breed commonly or exclusively in living flesh, causing a destruction of the tissues. Many species of insects are dependent upon mammalian blood for the necessary nutriment to bring about reproduction. Some insect larvæ are blood suckers. It is not at all uncommon for insect larvæ to be ingested in food and for them to continue their development in the intestines or other organs, often at the expense of the tissues. In some parts of the world insects are eaten as food by the natives, sometimes in a raw state, and it is not uncommon in such case for the natives to be infected with parasitic worms which pass their intermediate stages in the bodies of these insects.

4. *Where may insects obtain the organisms which cause disease?*—Disease organisms may be taken up by insects directly from the blood of an infected host or they may be obtained by sipping infected surfaces of the body or taken up from the feces or other excretions of an infected host. The insect may take up the organisms from these excretions either in its larval or its adult stage.

5. *How can the insect transmit the organ-*

[1] By insects, in this article, are meant those forms of invertebrates popularly called insects, including the Arthropoda.

ism?—The organism may be transmitted by the insect by direct inoculation through the proboscis, involving the active movement of the parasite, or the passive transmission of the parasite in the reflex actions which take place in the sucking of blood. The organism may be externally carried on the beak of the insect and mechanically transmitted at the time of sucking. It may be located in the mouth parts of the insect and burrow through at the same time the insect is feeding. It may be in a passive state on the insect and become stimulated to attack the host when it comes in contact with the warm body. The organism may be regurgitated by the insect on the body of its host and obtain entrance by its own activity, or by being scratched in, or by being licked up by the host.

On the other hand, the organism may pass through the insect, and pass out in its feces, or in malpighian excretions. It may be washed into the wound made by the sucking of the insect, by fluids excreted at the time of the feeding. It may remain in the feces on the host and ultimately be scratched in or licked up by the host.

The organism may be taken up by the insect and never normally pass out of the insect, but be inoculated by the crushing of its invertebrate host upon the body, and the scratching of infected portions of the insect's body into the blood.

Quite a series of disease organisms find their way into the hosts because of the habit of the host of feeding upon insects.

6. *What is the course of the organism in the insect?*—If the organism is taken up by the insect in its larval stage, the organism may pass directly through the larva and out in its feces and may quite conceivably pass in this manner through insect after insect larva before it finally finds a vertebrate host. The organism may be taken up by the larva and remain dormant in some portion of the larva's anatomy, or, on the other hand, it might undergo considerable development and multiplication in the larva and remain there through all the metamorphosis of the insect until the latter arrives at maturity, at which time development of the organism may begin or may continue.

Upon being taken up in the blood by the bite of the insect, the organism may lodge in the œsophagus and carry out all its metamorphosis there, or in some of the organs of the head and find its way into the salivary glands and through the salivary secretions into a new host.

It may, on the other hand, pass back into the gut, or into the stomach; from the stomach its path may lead in many directions. It may pass on in its course of development into the rectum and out in the feces, or it may enter the fatty bodies or pass into the general cavity of the insect, or it may migrate forward into the œsophagus and into the labrum; and it may pass into the malpighian tubules, or into the ovaries.

The organism may enter the eggs and remain therein through their development into the larvæ or nymphs and be transmitted at some stage of the development of the second generation.

7. *What is the course of the organism on leaving the insect?* The organism may leave the insect in the saliva and immediately enter the blood puncture. It may bore through the labrum of the insect at the time of feeding and enter the puncture. It may leave the rectum of the insect on the malpighian glands and be washed into the puncture by means of the secretions of the coxal glands, or some other excretions made at the time of feeding. It may be excreted in malpighian secretions, or rectal feces, or regurgitated in vomit, and may lie dormant on the skin of the host, or in the food of the host, until it is scratched into the blood, or is taken into the mouth.

On the other hand, it may be possible that the organism requires another host after the insect, and before it reaches its final host. There are cases on record of the insect being the first host, and two or three other animals in succession being hosts of later stages.

V. WHAT IS KNOWN ABOUT THE DISEASE TO BE INVESTIGATED?

It is a primary essential that all the workers be able to recognize the disease which they

are trying to study and that they be fully informed about it, so that they may be able to grasp possible solutions of their problem. They will, therefore, seek first to answer the following questions:

1. What is the history of the disease and how long has it been known? How serious has it been?

2. What is its distribution?

3. Does it occur in pandemic, epidemic, endemic or sporadic form?

4. In what seasons of the year is it most prevalent.

5. Is there any apparent relationship between its distribution and the physical, biological or climatic features of the countries where it occurs?

6. Does it affect any particular group, occupation, sex, race or nation of people, or any particular species of animal?

7. May any wild animal be considered as a reservoir?

8. Has immunity or difference of susceptibility been recognized and under what circumstances?

9. What are the symptoms of the disease?

10. What have autopsies shown?

11. What treatment has been designated?

12. What is known or suspected about its causation and dissemination?

13. What possible theories can be advanced to account for its causation and dissemination?

A little time spent in collecting those facts may save much effort later.

VI. WHAT INSECTS SHOULD BE INVESTIGATED?

A thorough entomological study of this question may prove a valuable short cut to the investigation. Many insects will be eliminated by the entomologist before he has finished his preliminary work. He will attempt to answer the following and many other questions and will probably have to answer them to the satisfaction of all his fellow workers.

1. What insects coincide in distribution with the general distribution of the disease?

2. What insects occur in peculiar habitats of the disease?

3. What blood insects occur in the locality under investigation?

4. What is the relative abundance of these insects?

5. Is there a coincidence between the season of abundance of any of these and of the disease?

6. What insects occur in the homes, nests or haunts of infected hosts?

7. What insects are found on infected hosts?

8. What insects occur in the working quarters of the patients?

9. What insects would be most apt to affect the particular group of hosts most susceptible?

10. What insects breed in or frequent the excreta of the hosts?

11. What insects are found at the food of the hosts?

12. What insects are found at the sources of the food of the hosts, such as the milk?

VII. WHAT IS NECESSARY IN THE TRANSMISSION EXPERIMENTS?

The investigations which have preceded will have narrowed the question down to certain species or groups of insects which need to be critically studied. All of those insects which come in contact with the blood of the patient, or the food of the patient, or the feces of the patient, must be given special attention. At this point the bacteriologist, protozoologist or the helminthologist finds his special work beginning. There will be many points which must be worked out by cooperation of the parasitologist and entomologist.

Considering first the blood-sucking insects, it is necessary to determine:

1. Can the particular insect take up the organism with the blood?

2. Does the organism pass into the intestinal canal or does it stop at some point en route?

3. To what extent is the organism digested by the insect?

4. In what organs of the insect can the parasite be demonstrated from day to day?

5. Are any changes in the organism demonstrable?

6. What path does the organism seem to follow in the insect's body from day to day?

7. Does this movement of the organism suggest whether the transmission is by inoculation or does it suggest that the organism will pass out of the body in some of the excreta?

8. Can the organism be demonstrated in the mouth parts of the insect at the time of feeding?

9. Can the organism be found in any of the excretions of the insect?

10. How long is it before the organism reaches the mouth or the rectum?

11. What is the earliest date at which it can be found in the feces?

12. What is the earliest date at which infectivity of the host can be obtained by the sucking of the blood?

12. What is the earliest date at which infectivity can be obtained by scratching in of feces or portions of the insects?

14. Can infection be obtained by either natural or artificial inoculation without demonstration of the organism?

15. Is the infective organism or virus filterable?

16. Can the virus or organism be transmitted hereditarily?

17. At what stage of development in the second generation does hereditary transmission become possible?

18. Can the organism be taken up by the immature stages, feeding in infected excreta?

19. Can the organism be taken up by immature stages of an invertebrate feeding on the host?

20. How long can the immature forms of the invertebrate, infected by whatsoever manner, retain the organism in their system?

21. Does it stay during metamorphosis?

22. Does it undergo any changes preceding or following metamorphosis?

23. At what stage in the metamorphosis does the insect begin to be infective after taking up such organisms?

24. How long can the insect remain infected?

VIII. HOW SHOULD EXPERIMENTAL INSECTS BE HANDLED?

A large proportion of the failures in studies of insect transmission in the past have arisen from improper handling of the insects. The breeding and handling of the insects is an art in itself, just as is the culturing of bacteria or protozoa. In fact there are more diverse requirements for handling insects of different species than can be found elsewhere in the animal kingdom.

1. *What must be known about the insect before beginning transmission experiments?*—The normal conditions of life of the insect must be ascertained: its reactions to heat and cold, moisture and dryness, disturbance, color, light, odor; its food, and the proper condition thereof; its methods of reproduction, and what food is necessary for reproduction; if soil should be provided, and what conditions it should be in; if water should be provided, and whether this water should be alkaline or acid, clear or containing foreign matter, and in such case what type of foreign matter; whether the water should be still or in motion, warm, moderate or cold.

2. *What type of breeding cage should be used?*—A breeding cage must be used which will most nearly enable the experimenter to keep the insects under control and yet reproduce essential conditions for maintaining reproduction. Much of this information is normal healthy life of the insects and normal available in entomological literature. Many insects probably involved in disease transmission have not been properly studied and breeding technique is yet to be worked out.

3. *Water is necessary in some form in practically all insect breeding.*—There are more failures to properly breed insects traceable to improper humidity, or to the lack of moisture in the proper form for the insects to drink. Much detailed observation may be necessary to obtain this important information in the case of many insects.

4. *There is a combination of temperature and humidity most favorable for life, for each species,* and *differing from one species to another.*

4. *The food of an insect must be in a particular condition in order to obtain normal breeding.* It may require a certain degree of

immaturity, ripeness or fermentation. It may require a certain degree of desiccation.

Many other details must be attended to by each specialist involved in the investigation, and we probably have yet to see a single disease problem which has been completely rounded out and solved for future generations.

IX. HOW SHALL WE RECORD OUR OBSERVATIONS?

Undoubtedly the most satisfactory method of making a large series of records is to use some type of loose-leaf card or sheet filing system. By such means one can always keep in an orderly arrangement all the facts so far obtained. In the case of investigations of the causation of a given disease, one of the most satisfactory methods which has been used for recording observations is to prepare a little blank booklet, which will fit the filing system, in large quantities, each book to represent a case. This book should contain pages for each phase of the question, with blanks covering all kinds of minutes about this phase. The whole series of observations can be tabulated for each point.

W. Dwight Pierce

Washington, D. C.

THE U. S. FOOD ADMINISTRATION'S WAR FLOUR

The U. S. Food Administrator, Mr. Herbert Clark Hoover, met and solved one of the greatest problems of the war. Prompt and seemingly drastic action was necessary in order to conserve wheat and vanquish the specter famine. The way in which this was achieved is so well known that recounting is unnecessary.

Bread is a nation's chief food, and in order to maintain an adequate supply during the war there were but two courses open for the Food Administrator to follow: To require the use either of substitutes, or of whole wheat flour, also known as long extraction flour. As head of the commission for relief in Belgium, Mr. Hoover was familiar with the results arising from the exclusive use of whole wheat flour in rationing a nation, and they were such as not to warrant a repetition of the experiment in the United States. It is most fortunate that no impractical dreamer, bent upon repeating an experiment that had failed was in charge of the U. S. Food Administration. Mr. Hoover's plans for the conservation of food and wheat in particular, rested upon basic scientific principles.

At the time Mr. Hoover assumed control there was a shortage of wheat and a fair supply of other cereals, particularly corn and barley. It was a question as to the best use of these cereals for human and animal foods. Corn and barley alone were not suitable for bread making, as they lack the gluten or binding material of wheat. Gluten is contained only in the floury part of the wheat and there is none in the wheat bran except that present in any flour that may have failed to be separated from the bran. As wheat bran and other wheat by-products contain no gluten binder they are on a par with corn and barley so far as physical bread-making value is concerned. The Food Administration took a broad view of the question and recognized that in addition to bread there must be maintained an adequate supply of milk and animal fats as pork.

Naturally the question hinged upon the relative merits of bran and corn and barley flours as human and animal foods. All available data plainly indicated that a pound of corn or barley flour furnishes the human body with more digestible protein and available energy than a pound of wheat by-product. In the animal ration, however, the wheat by-product has a higher productive value than the corn or barley.

Some recent experiments of the U. S. Department of Agriculture, conducted during the war by Arthur D. Holmes, specialist in charge of Digestion Experiments, Office of Home Economics, have an important bearing upon this subject. He reports that in eight digestion trials with men fed on fine bran bread in a simple mixed diet, an average of 44.7 per cent. of the bran protein was digested and 56.6 per cent. of the bran energy was available. In the case of unground bran 28 per cent. of the protein was digested and 55.5

per cent. of the energy was available. It is to be noted in five of these sixteen digestion trials negative results as to the digestibility of the protein were secured; that is the body actually sustained a loss of protein because of the bran consumed. "The reports made by the subjects regarding their physical condition vary from 'normal except for occasional slight pains in the stomach after eating to extreme laxative effect.'"[1]

Mr. Holmes reviews the earlier digestion trials of the U. S. Department of Agriculture, made by Woods and Merrill of Maine and Snyder of Minnesota, and reports:

	Digested Per Cent. Protein	Digested Carbohydrates
White flour	88.1	95.7
Whole wheat flour	81.9	94.0
Graham flour	76.9	90.6

Mr. Holmes's work shows that wheat bran has low digestibility as a human food. He says: "It is hoped the results of the experiments here reported when considered in connection with the available data on the digestibility of wheat will be of value in determining the most economical and physiological method of utilizing wheat for human food."

When used as animal food bran and wheat by-products have a much higher digestibility than when used as human food. Jordan reports that on an average 77.8 per cent. of the protein of bran and 79.8 per cent. of the protein of middlings are digested by animals. Thus it is quite evident that a pound of corn flour or barley flour furnishes more nutrients in a human ration than a pound of wheat by-product and on the other hand a pound of wheat by-product furnishes more nutrients in the animal ration than a pound of corn or corn flour and this is because the bran has a low digestibility as human food. In view of the facts it is quite plain the U. S. Food Administrator made no mistake in the adoption of the "substitute" flour as a conservation measure instead of the use of whole-wheat flour.

The Victory Bread of the United States made from 75 per cent. white flour (war standard) and 25 per cent. "substitutes" was far superior to the long extraction or War Bread of Europe containing no substitutes. A quotation from Alonzo E. Taylor's "War Bread" relative to the quality of the whole wheat or long extraction flours used in Europe is interesting:

> It is the experience of the nations at war in Europe that they would abandon higher extraction and return to mixed flours prepared from standard flour, provided this were possible. Breads made in England of standard (American flour diluted with an admixing flour) are much better than straight breads of 85 per cent. extraction flour. The Victory bread of the United States is so superior to the war bread of the Allies and of the enemies as to be past comparison. (Page 86.)

The "Substitute Plan" adopted by the United States Food Administration resulted in the conservation of more wheat, and the production of better bread and more nutritious than would have been possible if the whole-wheat plan, so vigorously advocated by some, had been adopted.

Dr. Armsby, director of the Institute of Animal Nutrition of the Pennsylvania State College, in his booklet "The Conservation of Food Energy," which was published about a year ago, gives some interesting data upon the utilization of cereals. He records the available energy per 100 pounds of flour as follows:

	Therms
Straight or standard patent	165.0
Whole wheat	156.1
Graham	150.5

After discussing the efficiency of animals to utilize cereals, and the food value of animal products, considering the overhead feed cost in producing such products, he concludes that:

> It is clear, then, that the endeavor should be to utilize as large a proportion of vegetable products as is possible directly as human food, leaving only the by-products to be fed to stock. In the case of cereals this is accomplished chiefly by some form of milling. (Page 58.)

It is to be noted that the figures which Dr. Armsby uses for flour milling (73 per cent.

[1] Page 17, U. S. Dept. Agr. Bulletin No. 751.

extraction) are for the pre-war flour. The U. S. Food Administration during the time of the shortage of wheat required approximately a 75 per cent. extraction. It is necessary to keep in mind this difference in the pre-war and the war standard milling basis in making comparisons. The tables show that when 100 pounds of wheat are milled into 73 pounds of flour (pre-war basis) and 27 pounds of feed, the flour being used as human food and the feed part for pork production, the pork in turn being used as human food, a total of 78 per cent. of the original therms of the wheat are utilized as human food. When, however, the calculations are made on the war standard milling (75 per cent. extraction) and the bran is converted into milk, and finally the cow into beef, while the middlings part of the wheat by-product is fed to pigs, which is the common practise in the use of wheat by-products, a return of over 80 per cent. of the therms of the original wheat is secured, which is somewhat more than is obtained when the wheat is milled and utilized as whole-wheat flour.

Even without the use of substitutes the Food Administration flour of 75 per cent. extraction, with a limit as to the amount of flour used per capita, would have been a better conservation measure than whole-wheat flour, because the therms from the milk, pork and small amount of beef are more valuable than the therms derived by man from the direct consumption of bran in whole-wheat flour bread. The quality of the therms as well as the quantity must be considered.

But the greatest conservation of wheat resulted when "substitutes" were used and a review of all the facts shows that the U. S. Food Administration could not have made the wheat supply "go farther" by milling it as whole-wheat flour. It would have gone no farther and the consumer would have had poor bread. The old adage aptly applies to this case—"Go farther and fare worse." The U. S. Food Administration's flour milling and bread-making plans accomplished results in the most efficient and satisfactory way possible.

Harry Snyder

EDWARD COWLES

Dr. Edward Cowles, who died at Plymouth, Mass., on July 25, at the age of eighty-two, was in many respects a remarkable man and had a remarkable career. He graduated from Dartmouth in 1859, where he received his M.D. two years later. He entered the Union Army, retaining his connection with it until 1872, when he became resident physician and superintendent of the Boston City Hospital, and in 1879 of the McLean Hospital for the Insane at Somerville. He directed its removal to Waverley and supervised the erection of perhaps what was then the finest hospital of its character in the world. This superintendency he resigned in 1892 because of ill health. The institution is to-day very largely a monument to his efficiency and foresight.

He was also a pioneer in the professional training of nurses for the care of the insane, but most important of all was the fact that he was the first in this country to conceive and carry out the system of scientific study of the insane within the institution itself with proper laboratory equipment and a corps of experts. It was due to his initiative that men like Dr. Adolf Meyer and Dr. Hoch were brought to this country and that other men now prominent were started on their careers. It is generally understood that his enthusiasm for the development of this scientific side of hospital work was one cause of his retirement.

He was professor of mental diseases at Dartmouth and instructor at Harvard Medical School until 1914, and for sixteen years was non-resident lecturer at Clark University, where he was one of the original trustees.

He was a member of the Alpha Delta Phi, Phi Beta Kappa, and Loyal Legion, and belonged to the St. Botolph Club of Boston, besides being a member of many scientific societies.

In his later years Dr. Cowles followed with intense interest the rise and decline of Kraepelin's views, with which his sympathy was limited. He was also interested in psychoanalysis, though not convinced of the extreme views of Freud. The list of his sci-

entific publications, though not large, constitutes an important contribution to American psychiatry, and two or three of them are hardly less than classic.

Personally he was one of the most attractive and charming of men because of his sympathy, unfailing flow of good humor, and his broad judicial mind.

G. Stanley Hall

July 28, 1919

SCIENTIFIC EVENTS

GAME CONSERVATION IN CANADA

A statement made by the Dominion Parks Branch, Department of the Interior, relating to the North-West Game Act, shows the efficacy of the act, in placing the fur trapping and trading industry under control, in the interest of game conservation. Organization in connection with the new Northwest Game Act passed in 1917 has taken place under the present government. The most notable and important feature in this connection is the fact that for the first time in the history of the Northland the fur trapping and trading industry has been placed under adequate control. Under the new act all white trappers and traders are under license.

In connection with the northern hinterland the government has also taken a very important step by the organization of a commission for the purpose of first, ascertaining the feasibility of the development of reindeer herds for the purpose of providing a meat supply for the Dominion, and, second, ascertaining the feasibility of the domestication of musk-ox in the north not only for the purpose of a meat supply but also for the purpose of a wool supply.

With respect to both these matters the situation is as follows: It is estimated that there is an area of about one million square miles in the north eminently suitable for the development of reindeer and musk-ox herds. Throughout the world there is a constant invasion of the areas used for cattle grazing through the lands being taken up for the production of fruits and cereals and the meat situation of the world is therefore gradually becoming more and more acute. Northern Canada is not suitable for the production of ordinary farm products but from the fact that millions of Barren land caribou, which physiologically are practically identical with domestic caribou, are known to thrive there at present; and from the fact that musk-oxen also thrive in the north there appears to be good reason for the expectation that with the development of reindeer and musk-ox herds the north may take the place of the more southerly portions of Canada in the matter of meat production.

While the migratory birds treaty was prior to the Union Government, organization has taken place since. This treaty with the United States provides for the protection both in the United States and Canada of practically all the beneficial migratory birds. Arrangements have been made with most of the provinces by which they have amended their game laws to harmonize with the terms of the treaty and by which the provincial game authorities enforce these laws. While the provincial laws have not all been satisfactorily amended, *e. g.* (maritime provinces) a staff of wardens has been appointed in these provinces and active steps have been carried on not only for the enforcement of law but for the education of the public as to the necessity of adequate protection of beneficial bird life.

In furtherance of the policy of bird conservation some twenty-eight suggested locations in the west for breeding sanctuaries have been inspected. In addition the Dominion has created Point Pelee, the most important bird area in Ontario, into a Dominion Park in order that it may be maintained as a sanctuary. The Dominion has also established as bird sanctuaries Bird Rocks, Bonaventure and Pierce Rock (all in Quebec), under the terms of the treaty and at the request of the Dominion the province of Quebec has passed provincial legislation on similar lines.

In addition the department has been issuing special bulletins and otherwise carrying on an educational campaign throughout Canada with the object of enlisting the sympathetic support of the public for bird protection.

Through the Advisory Board on Wild Life

Protection which operates under the authority of the Department of the Interior, the first thoroughly national conference on wild life protection which operates under the authority of the Department of the Interior, the first thoroughly national conference on wild life protection was held in Ottawa in February, 1919. Representatives of all the provinces and leaders in wild life protection took part in the conference. The purpose was to bring together every one in the Dominion specially concerned in the protection of the important wild life natural resources of the country and by the exchange of ideas to develop cooperation and efficiency throughout the country in the conservation of wild life.

A COLLECTING BOAT FOR THE NEW YORK AQUARIUM

The New York Aquarium will soon improve the method of collecting its living marine exhibits, the New York Zoological Society having provided funds for the construction of a large well-boat for that institution.

Hitherto the marine collections of the Aquarium have been transported in shipping tanks of limited size, such as could be readily handled on launches or wagons. This method is a primitive one and subjects the occupants of the tanks to more or less crowding and rough usage, with considerable losses in transit.

With a collecting boat available, specimens can be transferred directly from the nets used in capture to the spacious *well* of the boat, where they will remain undisturbed until their arrival at the sea wall behind the Aquarium.

The boat is nearly completed and will be launched early in August. It has a length of thirty-five feet and a depth of water in the well of two and a half feet. It is driven by a twenty-five-horse-power engine, and is also sloop rigged. There are cabin accommodations for four men and stowage space for nets and dredges.

This boat is of staunch construction and will be capable of going anywhere along the adjacent coast. The well being ten feet square, will not only accommodate fishes of larger size than it has hitherto been practicable to transport, but will carry large numbers of specimens without loss. It is important that living marine animals intended for exhibition should reach their destination not merely alive, but in condition to survive in captivity.

While the hundred or more exhibition tanks of the Aquarium usually contain five or six thousand specimens, of two hundred or more species, they have never exhibited half the wealth of species available in the New York region. This has been due solely to lack of facilities for getting the best results. The boat will be manned by the employees of the aquarium and should be able to do all the collecting that will be necessary on week-end trips. It is estimated that the cost of operating the boat will offset the cost of hiring wagons and launches, while the results secured will be immeasurably better.

The aquarium has for many years freely furnished small marine forms of life to the schools and colleges of New York City. An increased supply of such material should enable the aquarium to be still more generous in the distribution of its surplus for educational and research work, while the two millions of persons visiting the institution yearly, will see many northern marine forms that have not yet been exhibited alive.

C. H. Townsend

THE NATIONAL RESEARCH COUNCIL AND THE ROCKEFELLER FOUNDATION

At a meeting of the Executive Board of the National Research Council, held in June, on behalf of the Division of Physical Sciences, Mr. Millikan, as retiring chairman, recommended that a communication be sent to the Rockefeller Foundation requesting an annual appropriation of $20,000 for two or three years' traveling expenses in connection with the plan of stimulating and organizing research in physical subjects through the formation of groups of research men in these subjects. The executive board voted to approve the forgoing recommendations of the Division of Physical Sciences and that the chairman of the council be authorized to address a letter to the Rockefeller Foundation requesting an annual appropriation of $20,000 for two or three years in support of these plans.

The executive committee of the Division of Chemistry and Chemical Technology voted that the use of such a sum for a similar purpose in connection with chemical research would not be a wise expenditure at the present time for the following reasons:

1. The proposed plan, to be successful, would require the enlistment of the services of the best men in the country in traveling about and consulting with the various research workers. Such a utilization of their time would detract just so much from the progress of their own research work, with no certainty that the hoped-for stimulation and organization of the research workers of the country would exceed in value this loss.

2. The committee also feels that the first step in attaining the purposes of the proposed project should be a carefully prepared and indexed research census and that the promotion of cooperation between investigators working along similar lines can be best attained by calling a conference at some central point. The program of work for each such conference should be carefully worked out in advance by correspondence with the investigators, supplemented by such personal visits as the chairman of the Division may be able to make.

3. In view of the amount of preparatory work to be done in connection with securing the necessary data, corresponding with the research workers, and arranging the program for such conferences, the committee does not feel that during the first year it would be practicable to call more than five such conferences, but feels that a sum of money, not to exceed $7,000, could be wisely and fruitfully expended in this way during the first year and would be glad to join the Physics Division in requesting such a sum from the Rockefeller Foundation, to be used in this manner. It feels, however, that any requests for additional amounts should be based upon the knowledge and experience gained during the first year.

THE PATRON'S MEDAL OF THE ROYAL GEOGRAPHICAL SOCIETY

AT the anniversary of the Royal Geographical Society on June 2, the medals were presented in accordance with the announcement already made in SCIENCE. The president of the society, Sir Thomas Holditch, in presenting the patron's medal to Mr. Butler Wright for Professor W. M. Davis said:

The Patron's Medal is awarded to Professor William Morris Davis, of Harvard University, for his eminence in the development of physical geography. He is the most eminent of living American geographers, and has devoted his life to investigations in physical geography and to the teaching of geography as a university subject at Harvard, and as visiting professor in several European universities. At the commencement of his career he devoted much attention to meteorology, and his "Elementary Meteorology, 1894" is a standard work. Later he had practical experience as a geologist on the U. S. Geological Survey. For forty years he has given his main attention to the physical geography of the land surface, on which he has published several books and very many papers, some of the most important of these in the *Geographical Journal*. Professor Davis has travelled throughout North and South America and Europe, widely in Asia (including an expedition to Turkestan), Africa and Australasia. All the leading geographers of Europe have at one time or another taken part in geographical excursions on a great scale led by Professor Davis, and have borne witness to his extraordinary grasp of physical features and his power of exposition in the field. As a university teacher he introduced new methods of study, especially in his geographical laboratory at Harvard, which have proved of high value in scientific training. As a theoretical geographer he is known mainly by the completeness with which he worked out the geographical cycle of erosion, and the consequences which follow from the application of the conception. All the work of Professor Davis, both in the field and in the study, is marked by a forceful originality which has acted as a vivifying stimulus to several generations alike of disciples and critics. It is not too much to say that his writings have been largely instrumental in displacing German in favor of English as the language of advanced work in geography. Mr. Butler Wright has undertaken to accept the medal on behalf of Professor Davis, and it is with honor that I give it to so distinguished an American. There has always been a good feeling between American geographers and ourselves, and I hope that this will be a small token that it will continue.

SCIENTIFIC NOTES AND NEWS

THE fiftieth anniversary of the appointment of Dean George H. Perkins as professor of geology in the University of Vermont was celebrated at the recent commencement. The

exercises included addresses by prominent alumni and the presentation of a fine portrait by Carle J. Blenner, of New York, which is to hang in the library. For the past two years Dean Perkins has been acting president.

Lieutenant Colonel Wilder D. Bancroft, professor of physical chemistry at Cornell University, now on leave as acting chief of the Chemical Warfare Service, U. S. A., was the recipient of the honorary degree of doctor of science at the June commencement of Lafayette College.

On June 2, the Secretary of War conferred upon Lieutenant Colonel Edward Orton, Jr., Motor Transport Corps, formerly in charge of the Service Division, the distinguished service medal, with the following citation: "His untiring energy and splendid judgment were displayed in the efficient organization of the Engineering Division of the Motor Transport Corps, in bringing about standardization of equipment and supplies and in efficiently directing the forces of the motor industry to the mutual advantage of the Army and Industry itself." Lieutenant Colonel Orton was formerly dean of the college of engineering, Ohio State University.

The Ricketts prize of $250, given by the University of Chicago each year to its students for the best research work in bacteriology, was divided between E. B. Fink and F. W. Mulson, both doctors of philosophy.

Dr. Nelson W. Janney, formerly chief of the medical services of Base Hospital No. 99, American Expeditionary Forces, has resigned his professorship in the New York Postgraduate Hospital to succeed the late Dr. Nathaniel Bowditch Potter in the directorship of the Memorial Laboratory and Clinic for the Study and Treatment of Nephritis, Gout and Diabetes, Santa Barbara, Calif.

Howard Fonda has returned to his position in the department of bacteriology in the Long Island College Hospital, Brooklyn, after eighteen months' service in France.

Captain Oscar Riddle, Sanitary Corps, has returned from France and resumed his duties at the Station for Experimental Evolution, Cold Spring Harbor, N. Y.

The National Research Council has appointed a committee to encourage research in colloid chemistry and to foster the training of more colloid chemists, consisting of the following: Harry N. Holmes, *chairman*, Oberlin College; Jerome Alexander, New York City; W. D. Bancroft, Washington, D. C.; G. H. A. Clowes, Eli Lilly Co., Indianapolis; W. A. Patrick, Johns Hopkins University, J. A. Wilson, Milwaukee.

Professor E. B. Van Vleck, of the University of Wisconsin, has accepted an invitation as lecturer on mathematics at Harvard University for the second half of the ensuing academic year. Professor Van Vleck will give, besides a course in the calculus, one on the theory of functions of a complex variable and on the partial differential equations of mathematical physics.

Dr. Arthur M. Jordan returns to the University of Arkansas this year as head of the department of psychology after a two years' leave of absence spent in research work at Columbia University.

Donald B. MacMillan, leader of the Crocker Land expedition, will be provided with a small schooner with auxiliary power, to be christened *The Bowdoin*, when he leaves next summer on his next Arctic exploration trip, according to plans of the alumni of Bowdoin College. The schooner will be built to withstand the pressure of icefloes. The party, about ten in number, will devote two or three years in exploration work for the National Geographic Society.

The Lane Medical Lectures, which are held biennially at the Stanford University Medical School, will this year be given by Dr. Alonzo Englebert Taylor, professor of physiological chemistry at the University of Pennsylvania. Dr. Taylor has been representative secretary of agriculture on the War Trade Board for the past two years, and his lectures will deal with the results of his nutritional and medical survey of European food conditions. The exact

date has not been definitely decided upon, but will be about December 12, 1919.

The French branch of the Ramsay Memorial Fund, which is to commemorate the work of the late Sir William Ramsay, is asking for contributions to a fund of one million francs (£40,000) for the purpose of founding Ramsay Memorial Fellowships in chemical science, similar to those to be founded in Great Britain, such French fellowships to be available for bringing to England for purposes of research chemists trained in the universities and technical colleges of France. An appeal is being made throughout France. The French branch, of which Mr. Lloyd George is president, includes among its committee M. Pichon, M. Deschanel, Lord Derby, Lord Hardinge of Penshurst, Lord Bertie, and Sir George Riddell. The cost of founding each fellowship will be £6,000. It is hoped by their means to enlist the influence of the universities of the two countries in promoting helpful international relations. The appeal in France is being directed specially to British and American residents there, and to the large number of persons of all nationalities who have for many months past been in France, while performing duties connected with the Peace Conference.

The current agricultural appropriation bill carries the following items, largely to be devoted to scientific research in applied agriculture:

Weather Bureau	$1,880,210
Bureau of Animal Industry	5,783,231
Bureau of Plant Industry	3,379,638
Forest Service	5,966,869
Bureau of Chemistry	1,391,571
Bureau of Soils	491,235
Bureau of Entomology	1,371,360
Bureau of Biological Survey	742,170

This reaches a total of $21,006,284 out of the entire appropriation to the Department of Agriculture amounting to $33,900,211. The growth of the sums expended in research work under the Department of Agriculture has been enormous of late years, and seems to have been fully justified by results:

UNIVERSITY AND EDUCATIONAL NEWS

The building for the Kansas University Medical School for which $200,000 was appropriated by the recent legislature, will be erected provided the city of Rosedale furnishes the additional ground needed, which is valued at $60,000.

Excavation has been begun for a $70,000 engineering laboratory at the Oregon Agricultural College. It will be a two-story structure 220 by 63 feet and of brick and concrete construction.

Mrs. Alice Jessie Sheppee has given £2,000 to Oxford University for the foundation of a scholarship in engineering science.

Dr. W. W. Charters, dean of the College of Education at the University of Illinois, has resigned to accept a position with the Carnegie Institute of Technology as professor of education to do research work in connection with curriculum organization and construction.

Dr. C. A. Fischer, of Columbia University, has been appointed Seabury professor of mathematics and astronomy at Trinity College, Hartford.

J. P. Fairbank, B.S.C., University of Nebraska, who has been assistant professor and acting head of the department of agricultural engineering in the college of agriculture at the State College of Washington, Pullman, Wash., has been promoted to professor and head of the department of agricultural engineering.

Dr. Charles W. Easley, head of the department of chemistry at the University of Maine, has accepted a chair at Syracuse University. He is to be succeeded at Maine by Dr. Charles A. Brautlecht, of the Florida State College for Women, Tallahassee.

Mr. H. M. Showman, of the Colorado School of Mines, has been appointed assistant professor of mathematics in the Case School of Applied Science.

Dr. Leonard Doncaster, F.R.S., has been appointed to the Derby chair of zoology in Liverpool University.

MR. G. G. HENDERSON, M.A., D.Sc., LL.D., has been appointed to be Regius professor of chemistry in the University of Glasgow, in the room of the late Professor John Ferguson.

DISCUSSION AND CORRESPONDENCE

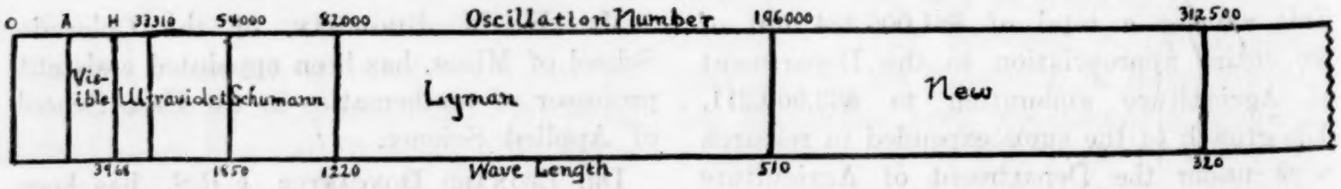
THREE FOURTHS OF AN OCTAVE FARTHER IN THE ULTRA-VIOLET

IN the *Physical Review* for August, 1918, Vol. 12, p. 167, we made a preliminary report upon a new method of obtaining grating-spectra in vacuo devised by one of us in the expectation of extending the limits of the ultra-violet spectrum. This report was made because both of us were engaged in war activities, and could not then push further the very significant results which we had already obtained—results which brought to light some 30 new zinc lines, the shortest wave-length among which had a value of 928 Ångstroms.

There is every reason to believe, however, that every element except hydrogen will emit line spectra corresponding to waves of higher frequency than this, the limiting frequency for a given element pushing farther and farther into the ultra-violet, the higher the atomic weight of the element.[1] With a properly chosen source therefore, the limit to the observable ultra-violet spectrum ought to be set solely by the properties of the grating and by those of the medium through which the radiation passes. Heretofore, it has been set by the limitations of the source and the properties of the absorbing medium. We felt that we had removed these limitations entirely by working in a very high vacuum with a type of source altogether new in vacuum spectrometry, and one which enabled us to use enormous energies in the highest attainable vacuum. In our preliminary report we stated that we had "indications of zinc lines of shorter wave-length than 928Å though no positive proof as yet."

Immediately upon release from the service we had a new grating constructed so as to obtain the maximum possible brilliancy, and a new and very efficient diffusion pump, so as to eliminate altogether, if possible, the appearance of all glow discharges and enable very high potentials (up to several hundred thousand volts) to be used in producing our hot sparks in vacuo. We hoped thus to bring up the intensities of the very short lines. We also eliminated from the vacuum chamber certain gas evolving bodies like ebonite which had appeared to limit our exposure times by reducing the periods during which we could operate our hot sparks without giving rise to glow discharges, and which in addition had very injurious effects upon our grating.

As a result of these improvements we are now maintaining an exhaustion of about 10^{-4} mm. of mercury while the arc is running. We have thus brought to light a considerable number of new zinc lines below 928Å of such wave-lengths as to add up to date three fourths of an octave to the ultra-violet spectrum directly accessible to study with a grating spectrometer. We shall be in position at a very early date to publish a series of actual photographs, but in this preliminary report will content ourselves with stating that we have ten definite reproducible zinc lines below 500 Ångstroms the shortest having a wave-length of 320 Ångstroms. It is interesting to note by reference to the accompanying figure which is an extension of one given by Lyman[2] that this represents an extension in frequency of about four times that accomplished by Schumann, namely, 82,000 — 54,000 = 28,000, and a trifle more than that represents thus far in Lyman's work, namely,



[1] "The Electron, etc.," University of Chicago Press, 1917, p. 202.

[2] "The Spectroscopy of the Extreme Ultra-violet," Longman's, 1914, p. 105.

196,000 — 82,000 = 114,000, the new region representing the increase in frequency number (oscillations per centimeter) of 312,000 — 196,000 = 116,000.

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THE PROBLEM OF THE BOY IN THE SWING

IN the current issue of SCIENCE (p. 20), Professor A. T. Jones has given an excellent account of just how a boy works up in a swing. To solve a problem in physics qualitatively and experimentally and at the same time to keep the explanation clear and correct as Professor Jones has done is often much more difficult than to explain the same phenomenon quantitatively. Nevertheless, his last paragraph, dealing with the energy relations, aroused my curiosity to discover just what the equation is which connects the work done by the boy's muscles with the increased rotational energy of the swing.

What here follows is practically as old as Huygens and is well known, but may interest those who have read the note referred to.

If the distance of the center of gravity of the boy from the limb about which the swing rotates be denoted by r, his mass by m; and the angular speed of the swing by ω, then his angular momentum will be $mr^2\omega$. Suppose now that the boy who has hitherto been standing up in the swing proceeds to sit down upon his heels; then if his angular speed is to be maintained equal to that of a rigid pendulum (isochronous with the swing loaded with the standing boy and vibrating through the same amplitude) a torqe, L, must be introduced whose value, at each instant, is

$$L = \frac{d(mr^2\omega)}{dt} = 2mr\dot{r}\omega.$$

Or, if no such external torque be applied, then the boy's motion will be retarded, at each instant, by just this torque.

The tangential *force* which opposes the motion, as the boy moves away from the axis, will evidently be

$$F = \frac{L}{r} = 2m\dot{r}\omega,$$

a quantity which becomes zero whenever either the radial speed, $\dot{r}$, or the angular speed, ω vanishes. Except for very small angles of deviation, θ, this retarding force will be but a small fraction of the tangential component of the weight, $mg \sin \theta$, which is urging the loaded swing to its lowest point.

When the boy rises to a standing position, the sign of $\dot{r}$ changes and his motion, instead of being retarded, is accelerated. Here is where the kinetic energy of the pendulum is increased; and the amount of it, if ds be an element of length of the arc, will be

$$Fds = 2m\dot{r}\omega ds.$$

But since ω is much greater near the middle than near the end of the vibration, the boy will expend more energy in lifting himself at the bottom of the swing than he will gain in seating himself at the end of the swing; this quite aside from the fact that, at the lowest point, he works against the whole of gravity while at the maximum elongation only the radial component of his weight is effective.

To perform the actual integration of the above expression one would have to know—or assume—the rate at which the boy seats himself, *i. e.*, one would have to know $\dot{r}$ as a function of s.

The phenomenon is, of course, not necessarily associated with gravity. The same description would hold for a mass in radial motion along the spoke of an oscillating horizontal wheel—say, the balance wheel of a watch.

For the student of dynamics, the essential interest of the problem appears to lie in the general fact that, although a central force does not alter the angular momentum of a body about a perpendicular axis through the center, such a force will, unless balanced, affect the kinetic energy of the body. Any one who wishes to understand this fact will try for himself the simple pendulum experiment recommended by Professor Jones, no matter how vivid his boyhood recollection of

the forward thrust which always accompanied his rising at the bottom of the swing.

Henry Crew

July 11, 1919

SCIENTIFIC BOOKS

The Evolution of the Earth and its Inhabitants. A series of Lectures Delivered before the Yale Chapter of the Sigma Xi during the Academic Year 1916–1917, by Joseph Barrell, Charles Schuchert, Lorande Loss Woodruff, Richard Swan Lull, Ellsworth Huntington. New Haven, Yale University Press. 1918.

This volume of essays prepared at the suggestion of Professor Lull, as president of the Yale Sigma Xi, is an interesting and unique addition to the literature of the subject. Each lecture is a separate essay, the preparation of which involved considerable time, thought and original work. The first lecture by Joseph Barrell, whose loss too early in life we all mourn, is entitled: "The Origin of the Earth." It was especially fitting that Professor Barrell should give this lecture since his work on the age of the earth had drawn him into close touch with the astronomical and mathematical work involved in the problem of the earth's origin. The lecture reviews the various attempts to explain the origin of the earth, giving chief attention to the planetesimal hypothesis. The phase of the work on which Professor Barrell's own work bears is to be found in his discussion of "The Origin of Ocean Basins," "The Reign of Surface Processes and Beginning of the Archean." He closes his lecture with the thought:

> It is not known how close they (oldest Archean rocks) stand in point of time to the formative processes whose description has been attempted. With these oldest rocks, the dimly known, heroic and mythical eon of the earth is closed and the first historic eon opens as the remote and long enduring division of geologic time.

Professor Schuchert's lecture "The Earth's Changing Surface and Climate during Geologic Time" reviews in part the lecture of Professor Barrell pointing out the climatic features involved and extending Barrell's observations into the known periods of geologic history. The fundamental factor in climate is atmosphere, and Professor Schuchert's discussion of the "Origin of the Atmosphere" opens the problems of "Climates of the Past" which he is able to discuss so well because of his extensive studies in paleontology and paleogeography.

The "Origin of the Earth's Waters," "Source of the Salts of the Ocean" and "Origin of the Sedimentary Strata" give the reader the most modern ideas of these fundamental aspects of geology and lead up to the discussion of the changes in surface features which the earth has experienced in its evolution from a primordial mass to the recent. The discussion is accompanied by maps and tables explaining in a graphic way the thoughts of the lecture. Professor Schuchert is inclined to the view that geologic time has endured about 800 million years, supporting the ideas of Matthew, Shapley and Barrell from other evidences.

Professor Woodruff in his lecture on "The Origin of Life" has attacked a much more difficult problem because of the great dearth of evidence or analogy. He has handled the difficult task cleverly in discussing, first the nature of protoplasm, the individuality of organisms, and by giving an interesting historical account of "The Theories of the Origin of Life" under the following titles: "Vitalism," "Cosmozoa Theory," "Pflüger's Theory," "Moore's Theory," "Allen's Theory," "Trolands Enzyme Theory," "Osborn's Theories." It is rather disappointing to have Huxley and Darwin close this lecture, since it would have been extremely pleasing to know what Woodruff himself thinks about the "Origin of Life," and his research work has certainly given him some idea on this interesting topic.

No one could speak with more knowledge of facts as to the "Pulse of Life" than Professor Lull in the fourth lecture.

> The stream of life flows so slowly that the imagination fails to grasp the immensity of time required for its passage, but like many another stream, it pulses as it flows. There are times of quickening, the expression points of evolution, and

these are found to be coincident with geologic change.

The lecture might well have been called "The Philosophy of Paleontology," though the evidences are drawn chiefly from the vertebrates, the discussion being illumined by a very interesting diagram of the pulse of life, showing the influences of climate, continental elevation, and extinctions on the pulsations of vertebrate life. The discussion follows such interesting topics as "Emergence of Terrestrial Vertebrates," "Evolution of Terrestrial Foot," "Origin of Reptiles" and closes with the interesting comparison of the graph produced by a sphygmograph, recording the movements of the human pulse, with the graph deduced from the study of geologic and paleontologic evidences, recording the pulsations of life through many millions of years.

In the closing lecture of the series Professor Huntington discusses "Climate and the Evolution of Civilization." This is a proper closing for such a series, thus bringing out the influence of physical factors in the highest form of evolution. The lecture discusses the influence of climatic influence on certain primitive tribes and nations of America and is illustrated by a number of climographs.

The volume is thus a discussion, in brief form, of the chief factors bearing on the evolution of the earth and its inhabitants from the cosmical origin to the culmination of the highest phylum in the production of a high type of civilization.

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SPECIAL ARTICLES

A PRACTICAL LONG-PERIOD SEISMOGRAPH

A seismograph which is to record earth-motion with fidelity must have a "steady point" which shall be uninfluenced, as nearly as may be, by that motion. In existing instruments this steady point is the center of oscillation of a mass so suspended that when disturbed it vibrates slowly about an equilibrium position. The relative motion of the ground with reference to this steady point is then recorded with magnification on a sensitive surface by means of a suitable optical or mechanical system.

With suitable damping, and with a faultless recording system, the resulting record has considerable accuracy for rapid seismic motion whose period is not greater than the free period of the instrument; for slower motion the accuracy declines rapidly; and the instrument is wholly insensitive to motion whose period is several times greater. It is therefore of prime importance that the period of the instrument shall be as great as possible.

When this period is made large, however, a difficulty arises in that the equilibrium position of the heavy mass changes slowly, due to tilts of the support in case of the horizontal pendulum, to temperature changes in the vertical-motion instrument, and in both due to other less important causes. With the ordinary method of recording, these slow wanderings are magnified in the record, increasing the technical difficulty of obtaining the record, and excessively increasing the size of sensitive surface required. For these reasons practical seismometry has limited itself to periods rarely exceeding twenty seconds.[1]

Galitzin was the first to employ a method which permitted the recording of seismic motion without registering the wanderings. He employed an electromagnetic system which depended upon the velocity of the earth-motion rather than upon the displacement, thus avoiding the slow changes. In doing this, however, he sacrificed the flatness of the magnification curve of his instrument, so that his record not only did not represent the seismic motion directly, but did not permit its computation except in the case where such motion was simply harmonic—a case which does not occur in practise.

The writer has devised a method of record-

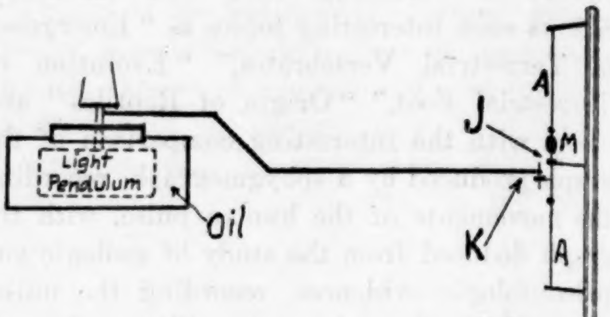
[1] From the literature one might infer that in practise, there is a low upper limit to the period of the horizontal pendulum. Walker sets this limit for laboratory purposes at forty seconds. But Omori has achieved much longer periods. The first pendulum constructed by the writer in the College of Hawaii laboratory had a period of three minutes.

ing which ignores the objectionable slow wanderings of the heavy mass, and yet records displacements directly, retaining the flat magnification curve of the best seismographs, and permitting the use of very long-period instruments. The essential feature of this recording system is that the (apparent) motion of the heavy mass is transmitted through a viscous medium to a light system having a shorter period of its own: the viscous coupling amounting to direct connection for the seismic motion of a period up to that of the pendulum, but permitting the light system to avoid the very slow changes.

This method of recording may be explained by describing the system as applied to a certain horizontal pendulum at the College of Hawaii. The adaptation to vertical-motion instruments will suggest itself.

Attached to the seventy-pound mass of a suitably damped horizontal pendulum is a horizontal cylindrical vessel of heavy oil, the axis of the cylinder being in the direction of motion of the pendulum. The cylinder is two inches in diameter, and has an opening in the form of a longitudinal slit one half inch wide at the top, around which there is a rim, to allow the surface of the oil to be somewhat higher than the top of the cylinder. In the cylinder, immersed in the oil, is the mass (about one pound) of a second horizontal pendulum. This mass is itself cylindrical and forms a piston within the larger vessel, though not touching it. The axis of rotation of this light pendulum coincides approximately with that of the heavy pendulum, but is sufficiently inclined to give a free period short enough to allow of registration, and it is the motion of this light pendulum which is recorded. It will be seen that for ordinary seismic motion the two pendulums form a single mass, but that the oil can flow so as to allow the light pendulum to retain approximately its own equilibrium position.

Registration is accomplished photographically as follows: A piece of no. 36 nickel wire two inches long is soldered at its ends to pieces of galvanometer suspension ribbon AA (see figure) each three inches long, and stretched between spring supports in a vertical position. At its middle this nickel wire passes through the hole of a watch jewel J of suitable size held by an arm fastened to the support, preventing transverse vibration. Fixed to the nickel wire just below the jewel is an arm of wire, one fourth inch long, holding at its other end a similar jewel. Through the hole of this jewel passes a short piece of no. 36



wire K attached to the end of an aluminum wire which is itself attached to the light pendulum by a flexible connection. The motion of the pendulum is thus transmitted to the mirror M which is cemented to the nickel wire at another point. The rocking of the mirror is recorded in the usual way on bromide paper.

This system succeeds with a magnification of 75 on a pendulum moving sometimes half an inch in the course of the twenty-four hours, with a lateral drum-motion of an eighth inch per (hourly) revolution.

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